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APPLICATION

REVISIONS

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Wulfsberg Electronics
A Chelton Group Company

AIRPLANE FLIGHT MANUAL SUPPLEMENT

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Chelton Flight Systems
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FAA APPROVED
AIRPLANE FLIGHT MANUAL SUPPLEMENT
Or
SUPPLEMENTAL AIRPLANE FLIGHT MANUAL
For
FLIGHT LOGIC SYNTHETIC VISION EFIS as installed in

_____

Make and Model Airplane

Registration Number _____

Serial Number _____

This document serves as a Airplane Flight Manual Supplement or a Supplemental Airplane Flight Manual when the aircraft is equipped with the Flight Logic Synthetic Vision EFIS system. This document must be carried in the airplane at all times when the Flight Logic Synthetic Vision EFIS system is installed in accordance with Supplemental Type Certificate No. _____. The information contained in this document supplements or supersedes the information made available to the operator by the manufacturer in the form of clearly stated placards, markings, or manuals as required by CAR 3.777(b) or in the form of an FAA approved Airplane Flight Manual, only in those areas listed herein. For limitations, procedures, and performance information not contained in this document, consult the basic placards, markings, or manuals or the basic FAA approved Airplane Flight Manual.

FAA Approved: _____
Manager, Anchorage Aircraft Certification Office
Federal Aviation Administration
Anchorage, Alaska
Date:_____

Chelton Flight Systems
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Revision Record

150-045262

Revision	Notes	Date	Author
Rev. IR	Initial Release	12-16-02	BLJ

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LIST OF ILLUSTRATIONS

1.0 GENERAL

The Chelton Flight Systems Flight Logic Synthetic Vision EFIS is a complete flight and navigation instrumentation system that provides information to the pilot via the Integrated Display Unit (IDU). The IDU can be configured as a Primary Flight Display (PFD), or a Multi-Function Display (MFD) depending on installation. The PFD is a three-dimensional, enhanced synthetic vision display that provides forward-looking terrain, attitude, altitude, airspeed, vertical speed, direction, and Highway-in-the-Sky navigation. The MFD can display a moving map, traffic, terrain, weather, HSI or a combination thereof.

The Flight Logic Synthetic Vision EFIS provides visual and aural warnings, cautions, and advisories for system monitoring. Warnings consist of a red flag on the IDU and a voice warning that repeats until acknowledged by the pilot. Cautions consist of an amber flag on the IDU and a one-time voice report or high/low-tone warble. Advisories can consist of an amber or green flag depending on condition, and a single voice report or warble.

A VFR Flight Logic Synthetic Vision EFIS installation consists of a single IDU that can alternate between PFD and MFD, an Air Data Computer (ADC), a Global Positioning System (GPS) receiver, an Attitude and Heading Reference System (AHRS) unit, and a Analog Interface Unit (AIU). The IFR Flight Logic Synthetic Vision EFIS installation consists of at least one IDU permanently assigned as the PFD and up to three additional IDUs assigned as PFD/MFD, up to two ADCs, up to two GPS receivers, up to two AHRS units, and a AIU with reversionary switching as needed.

Each IDU contains all necessary hardware, software, and databases and operate independent of the other IDUs installed. The IDU consists of a high-brightness backlit AMLCD screen, eight menu buttons, a selection/enter encoder, a display brightness encoder, and an optional slip indicator. The buttons, bezel and optional slip indicator are backlit and adjustable by the brightness encoder.

REMOTE SENSORS

The Crossbow Technologies AHRS500GA AHRS unit provides attitude and heading Reference to the Flight Logic Synthetic Vision EFIS system. The AHRS500GA employs three, solid-state angular-
Rate sensors, three solid-state accelerometers, and three fluxgate magnetometers Encased in a single sealed all-metal housing that is isolated from external shock and Vibration. The internal power supply provides 250 ms of standby power in case of a Temporary power loss.

The FreeFlight Systems Wide Area Augmentation System-Global Positioning Sensor (WAAS-GPS) provides GPS data for aircraft, navigation, obstruction, and terrain data in a self contained unit. The WAAS-GPS consists of an antenna mounted on top of the airframe, and a Sensor/Processor Unit (SPU) located remotely in the avionics area.

The Shadin 2000 ADC provides airspeed, altitude, fuel flow, and Outside Air Temperature (OAT) for processing in the Flight Logic Synthetic Vision EFIS system. The ADC is a self-contained remote mounted unit.

The Chelton Flight Systems AIU is a remote mounted unit that converts analog signals from a radar altimeter, an ADF receiver, flight director, marker beacon, and up to two Nav/GS receivers for processing in the EFIS II system. The AIU receives vertical and lateral data from the EFIS for autopilot drive.

A complete description of the functions of the EFIS is contained in the Chelton Flight Logic Synthetic Vision EFIS Pilot's Operating Guide and Reference, Doc. No. 150-045240.

Figure 1: PRIMARY FLIGHT DISPLAY

Figure 2: MULTIFUNCTIONAL DISPLAY

2.0 LIMITATIONS

A. The Chelton Flight System Flight Logic Synthetic Vision EFIS Pilot's Operating Guide and Reference Document No. 150-045240 (latest FAA approved revision) must be immediately available to the pilots. The software status stated on the pilot's manual must match that displayed on the equipment.

A. For IFR operation, the Flight Logic Synthetic Vision EFIS system must be configured with 2 or more IDU's.

B. Single IDU installations are limited to VFR operation only.

C. Do not power AHRS before engine start. Low voltage can cause erroneous initialization.

D. AHRS must be stationary during and for ten seconds after power up.

E. Do not continue an instrument approach beyond the decision height or below the minimum descent altitude unless the landing environment is visible according to the Federal Aviation Regulations.

F. GPS errors can exceed 100 meters under extreme conditions.

G. Navigation and Terrain Separation must not be predicated upon the use of the terrain function. Terrain data is advisory only.

H. The AFM Supplement is intended for use with the Flight Logic Synthetic Vision EFIS System containing software versions 4.0 or FAA approved version.

I. The pilot's IDU's must be operational for take-off.

J. Airplane operation must not be predicated on the use of the MFD page and emergency checklists.

K. The composite mode is to be used only after a failure of an IDU. Display transfer may be used in case of an IDU failure.

L. Airspeed readout may be used as primary airspeed indication.

M. The estimated AGL Indication, whose source of information is the aircrafts pitot/static system, is an estimate of the aircraft height above the ground and is displayed anytime that value is $\leq$ 2500 feet.

N. The skyway is a series of boxes that form a 3-D "tunnel" along the desired route of flight in both VFR and IRF modes (the symbology is virtually identical), and can be displayed for any runaway that has an instrument approach. It should be further noted that the skyway series of boxes was designed to lessen the pilot's workload in a non-aggressive flight path.

O. During a Non-Precision Approach, the primary instruments are the Course Deviation Indicator (CDI) and the Altimeter. This Flight Logic Synthetic Vision EFIS will fly this approach. The Flight Logic Synthetic Vision EFIS calculates a glidepath between the Final Approach Fix (FAF) and Missed Approach Point (MAP) attitudes. When approach is active, vertical deviation is calculated using aircraft position and baro-corrected altitude relative to this glide path. A Flight Path Angle (FPA) is coded in the Navigation database, which takes into account the step-down fix location. This FPA will always be greater than a computed FPA between the FAF and MAP when a step-down fix is present.

P. When the database FPA is greater than the EFIS computed FPA between FAF and MAP, the FAF altitude will be recalculated to a higher altitude using the data base supplied FPA, such that a single glidepath will be generated which clears all step-down fixes in the approach procedure.

Q. As always, it is the pilot's responsibility to observe and assure that the published MDA is not violated.

NOTE: When viewing Approach Definition, there may be a slight difference between the EFIS displayed coordinates for the end-of-approach point and the coordinates found on the approach chart. This is due to the electronic data base update occurring before a revised chart is available. These minor variations are considered normal. Minor variations (if any) do not compromise the approach accuracies as set forth in AC 20-130. However, it is the pilot's responsibility to verify that these variations are within the accuracies as set forth in AC 20-130.

R. In the event the Flight Logic Synthetic Vision EFIS system loses the AHRS input, the loss of Actual Heading and Attitude will occur. The pilot will revert to the aircraft's standby compass and standby heading indicators, no further impact will be noted to the Flight Logic Synthetic Vision EFIS system's functions**.**

S. Interpretation and use of Terrain Depiction on the PFD – actual terrain can be higher than indicated.

T. Data Base updates, Prior to each flight, current database date should be verified (28 day cycle).

3.0 EMERGENCY/ABNORMAL PROCEDURES

3.1 EMERGENCY PROCEDURES

A. In the event of a failure of pilot IDU's, secondary flight instruments or Standby Instrument (whichever is installed) will be utilized to complete the current flight and the faulted units must be replaced/repaired before further flight.

B. In the event of an electrical power failure, the Flight Logic Synthetic Vision EFIS system will be automatically switched to the aircraft battery bus. The "ON BATT" (amber) annunciator will illuminate indicating that the Flight Logic Synthetic Vision EFIS system is on the aircraft battery.

C. OPTIONAL DEDICATED BATTERY INSTALLED:
In the event of an electrical power failure, a dedicated battery will automatically supply electrical power to the EFIS II system. The "BATT ARM" (white) annunciator will extinguisher and the "BATT ON" (amber) annunciator will illuminate indicating that the Flight Logic Synthetic Vision EFIS system is on the dedicated battery. The dedicated battery will support the pilot's Flight Logic Synthetic Vision EFIS system for a minimum of one hour.

3.2 ABNORMAL PROCEDURES

The Flight Logic Synthetic Vision EFIS system provides reversionary modes in the event of component failures, attitude failure or heading failure. The following sections detail these procedures.

A. IDU FAILURE

In the event of a failure of the Pilot's/Co-pilot's Primary Flight Display (PFD) – Attitude Direction Indicator or the Multifunction Display (MFD) – Horizontal Situation Indicator (HSI), the reversionary mode may be selected by means of selecting the appropriate menu and then selecting reversion allowing the PFD (ADI) data to be overlaid on the MFD (HSI).

B. PILOTS ATTITUDE FAILURE

Loss of attitude will occur on the primary indicators IDU (PFD). Refer to Table 5 and 6.

C. PILOTS HEADING FAILURE

Loss of heading will occur on the primary indicators IDU (MFD). Refer to Table 3 and 4.

D. GPS FAILURE

GPS failure will result in an amber caution flag showing time since last GPS fix and a “GPS failure. GPS failure” voice annunciation.

GPS failure causes the EFIS to lose updating of aircraft position, ground speed and ground track and the ability to calculate wind information. In this condition, the EFIS II operates in “dead reckoning” mode and continues to provide navigational position, groundspeed and ground track information based upon the last known wind and current air data and heading. A “NO GPS” caution flag is displayed and a “GPS failure. GPS failure” voice annunciation is announced. The primary flight and moving map displays are affected shown in Tables 1 & 2.

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GPS FAILURE – PRIMARY FLIGHT DISPLAY EFFECTS
Table 1

SCREEN COMPONENT	FAILURE MODE OPERATION
Airspeed Functions	Normal Operation
Altimeter Functions	Normal Operation
Altimeter Setting	Normal Operation
Bank Angle Scale	Normal Operation
CDI	Presented using inertial dead-reckoning based on last known wind information.
Conformal Runway	Presented using inertial dead-reckoning based on last known wind information.
Bearing to Waypoint	Presented using inertial dead-reckoning based on last known wind information.
Directional Scale	Normal Operation
AGL Ind.	Either radar altitude of barometric altitude less database elevation based upon inertial deadreckoning.
Flight Path Marker	Presented using inertial dead-reckoning based on last known wind information.
G-Meter	Normal Operation
Ground Track	Presented using inertial dead-reckoning based on last known wind information.
Heading Indicator	Normal Operation.
Horizon	Normal Operation
Minimap	Presented using inertial dead-reckoning based on last known wind information.
Pitch Limit Indicator	Normal Operation
Pitch Scale	Normal Operation
Highway in the Sky	Presented using inertial dead-reckoning based on last known wind information.
Terrain/Obstructions	Not Presented
Clock Functions	Normal Operation
VSI	Normal Operation
Navigation Symbology	Presented using inertial dead-reckoning based on last known wind information.
Waterline Symbol	Normal Operation
Waypoint Symbol	Presented using inertial dead-reckoning based on last known wind information.
Waypoint Brg./Dist.	Presented using inertial dead-reckoning based on last known wind information.
Traffic	Normal Operation.
Speed Trend	Normal Operation.
Dynamic Stall Speed	Normal Operation.

GPS FAILURE – NAVIGATION DISPLAY EFFECTS
Table 2

SCREEN COMPONENT	FAILURE MODE OPERATION
Aircraft Position	Presented using inertial dead-reckoning based on last known wind information.
Special Use Airspace	Presented using inertial dead-reckoning based on last known wind information.
Waypoint Pointer	Presented using inertial dead-reckoning based on last known wind information.
Active Flight Plan Path	Presented using inertial dead-reckoning based on last known wind information.
Glide Range	Presented using inertial dead-reckoning based on last known wind information.
Groundspeed	Presented using inertial dead-reckoning based on last known wind information.
Ground Track	Presented using inertial dead-reckoning based on last known wind information.
Heading Indicator	Normal Operation
Navigation Symbology	Presented using inertial dead-reckoning based on last known wind information.
Outside Air Temperature	Normal Operation
Projected path	Presented using inertial dead-reckoning based on last known wind information.
Traffic	Normal Operation
Terrain/Obstructions	Not Presented
Clock Functions	Normal Operation
Waypoint Brg./Dist.	Presented using inertial dead-reckoning based on last known wind information.
Wind information	Last known wind is saved during GPS failure.
WX-500 Data	Normal Operation
Compass Rose	Normal Operation.
Fuel Totalizer Functions	Presented using inertial dead-reckoning based on last known wind information.
True Airspeed	Normal Operation
Density Altitude	Normal Operation

E. ADC FAILURE

ADC failure will result in a loss of air data. This failure causes a “No Air Data” cautionary flag to be displayed. The primary flight and navigation displays are affected as shown in table 3, 4.

ADC FAILURE – PRIMARY FLIGHT DISPLAY EFFECTS
Table 3

SCREEN COMPONENT	FAILURE MODE OPERATION
Airspeed Functions	Not Presented
Altimeter Functions	Not Presented
Altimeter Setting	Not Presented
Bank Angle Scale	Normal Operation
CDI	Normal Operation.
Conformal Runway	Not Presented.
Waypoint Pointer	Normal Operation..
Heading Scale	Normal Operation
AGL Ind.	Either radar altitude or geodetic less database elevation.
Flight Path Marker	Not Presented.
G-Meter	Normal Operation
Ground Track	Normal Operation.
Heading Indicator	Normal Operation.
Horizon	Normal Operation.
MiniMap	Normal Operation.
Pitch Limit Indicator	Not Presented.
Pitch Scale	Normal Operation.
Highway in the Sky	Not Presented.
Terrain and Obstructions	Not Presented.
Clock Functions	Normal Operation.
VSI	Not Presented.
Waterline	Expanded to large attitude bars.
Waypoint Symbol	Not Presented.
Waypoint Brg./Dist	Normal Operation.
Traffic	Normal Operation.
Speed Trend	Not Presented.
Dynamic Stall Speed	Not Presented.

ADC FAILURE – NAVIGATION DISPLAY EFFECTS
Table 4

SCREEN COMPONENT	FAILURE MODE OPERATION
Aircraft Position	Normal Operation
Special Use Airspace	Special-use airspace boundaries are drawn with bold lines due to lack of aircraft altitude data.
Waypoint Pointer	Normal Operation
Active Flight Plan	Normal Operation
Glide Range	Not Presented.
Ground Speed	Normal Operation..
Ground Track	Normal Operation
Heading Indicator	Normal Operation
Navigation Symbology	Normal Operation
Outside Air Temperature	Not Presented.
Projected Path	Normal Operation
Terrain and Obstructions	Not Presented.
Clock Functions	Normal Operation
Waypoint Brg./Dist.	Normal Operation
Wind Information	Not Presented.
WX-500 Data	Normal Operation
Fuel Totalizer Functions	Not Presented.
Compass Rose	Normal Operation
True Airspeed	Not Presented.
Density Altitude	Not Presented.

F. AHRS FAILURE

Failure of the AHRS results in a loss of attitude, magnetic heading and G force information. This causes the “No Attitude” cautionary flag to be displayed and an “Attitude failure. Attitude failure” aural annunciation is announced.. The primary flight and navigation displays are affected as shown in Table 5 & 6.

AHRS FAILURE – PRIMARY FLIGHT DISPLAY EFFECTS
Table 5

SCREEN COMPONENT	FAILURE MODE OPERATION
Airspeed	Normal Operation
Altimeter	Normal Operation
Altimeter Setting	Normal Operation
Bank Angle Scale	Not presented
CDI	Normal Operation
Conformal Runway	Presented aligned with aircraft track.
Waypoint Pointer	Presented aligned with aircraft track.
Heading Scale	Presented aligned with aircraft track.
AGL Ind.	Normal Operation
Flight Path Marker	Presented aligned with aircraft track.
G-Meter	Not Presented
Ground Track	Presented aligned with aircraft track.
Heading Indicator	Not presented.
Horizon	Not Presented
Minimap	Presented aligned with aircraft track.
Pitch Limit Indicator	Based on 1G stall speed.
Pitch Scale	Not Presented.
Highway in the Sky	Presented aligned with aircraft track.
Terrain/Obstructions	Presented aligned with aircraft track.
Clock Functions	Normal Operation
VSI	Normal Operation
Waterline Symbol	Large attitude bars presented and crossed out with a bold red “X”.
Waypoint Symbology	Presented aligned with aircraft track.
Waypoint Brg./Dist.	Normal Operation
Traffic	Presented aligned with aircraft track.
Speed Trend	Not Presented.
Dynamic Stall Speed	Based upon 1G stall speed.

AHRS FAILURE – NAVIGATION DISPLAY EFFECTS
Table 6

SCREEN COMPONENT	FAILURE MODE OPERATION
Aircraft Position	Normal Operation
Special Use Airspace	Aligned with aircraft track in heading-up mode.
Waypoint Pointer	Aligned with aircraft track in heading-up mode.
Active Flight Plan Path	Aligned with aircraft track in heading-up mode.
Glide Range	Presented using last-known wind information. Aligned with aircraft track in heading-up mode.
Ground track	Aligned with aircraft track in heading-up mode.
Ground Speed	Normal Operation
Heading Indicator	Not Presented.
Navigation Symbols	Normal Operation Aligned with aircraft track in heading-up mode.
Outside Air Temperature	Normal Operation
Projected path	Not Presented
Traffic	Normal Operation
Terrain/Obstructions	Normal Operations
Clock Functions	Normal Operation
Waypoint Brg./Dist.	Normal Operation
Wind	Not Presented
Compass Rose	Aligned with aircraft track in heading-up mode.
Fuel Totalizer Functions	Normal Operation
WX-500 Data	Normal Operation
True Airspeed	Normal Operation
Density Altitude	Normal Operation

Note: For “Multiple Sensor Failure” conditions refer to Chelton Pilots Operating and Reference Manual document No. 150-045240.

4.0 NORMAL PROCEDURES

4.1 POWER UP and SELF TEST

- Apply power to the IDU by applying aircraft power and placing the EFIS left/right Master Switch(s) in the ON position.
- System will perform an automatic Self-Test (@ 45 seconds). Passing is indicated by a "Push any Key to Continue" screen. Failure is indicated by a "Bios error", "system not found", blank screen, screen with no image, continual screen resetting (booting) or a "CRC error".

4.2 OPERATION

Normal operating procedures are outlined in Chelton Flight Systems Flight Logic Synthetic Vision EFIS Pilots Operating Guide and Reference Doc. No. 150-045240 Section 5, "Step by Step" Procedures.

4.3 DISPLAY ANNUNCIATION / MESSAGES

Caution / Warning / Advisory System is outlined in Chelton Flight Systems Flight Logic Synthetic Vision EFIS Pilots Operating Guide and Reference Doc. No. 150-045240 Section 2, "System Overview".

4.4 SYSTEM ANNUNCIATORS /SWITCHING

NOTE: Actual switches installed are dependant on aircraft configuration

A. LEFT EFIS MASTER SWITCH

The Left EFIS Master Switch is a 2-position toggle switch located on the Pilot's instrument panel. The collocated "EFIS PWR ON" annunciator will illuminate (Green) when the EFIS Master Switch is in the "ON" position

B. RIGHT EFIS MASTER SWITCH

The Right EFIS Master Switch is a 2-position toggle switch located on the Copilots instrument panel. The collocated "EFIS PWR ON" (Green) annunciator will illuminate when the Right EFIS Master Switch is "ON".

C. "ON BATT" ANNUNCIATOR

In the event of an electrical power failure, the Flight Logic Synthetic Vision EFIS system will be automatically switched to the aircraft battery bus. The "ON BATT" (amber) annunciator will illuminate indicating that the Flight Logic Synthetic Vision EFIS system is on the aircraft battery.

D. "BATT ON/BATT ARM" ANNUNCIATOR

In the event of an electrical power failure, an optional dedicated battery will automatically supply electrical power to the Flight Logic Synthetic Vision EFIS system. The "BATT ARM" (white) annunciator will extinguisher and the "BATT ON" (amber) annunciator will illuminate indicating that the Flight Logic Synthetic Vision EFIS system is on the dedicated battery.

E. G/S CANCEL ANNUNCIATOR SWITCH

The "G/S CANCEL" (Amber) annunciator switch, when illuminated, cancels the visual and audible GPWS (mode 5) functions. The GS Inhibit function is not annunciated on the EFIS II display. If the alarm is activated, the pilot can silence it by activating the "G/S CANCEL" Switch. The alarm is then inactive until the aircraft altitude is above 2000 ft AGL or descending below the automatic inhibit altitude (50 feet AGL with radar altimeter AGL source or 100 feet AGL with terrain database AGL source). The "G/S CANCEL" annunciator switch is located near the pilot's Flight Logic Synthetic Vision EFIS System Indicator.

F. LOW ALT ANNUNCIATOR SWITCH (Helicopters Only)

The "LOW ALT" (amber) annunciator switch, when activated, illuminates and inhibits and modifies HTAWS alerting functions to allow normal operation at low altitudes. The "LOW ALT" annunciator switch is located near the Flight Logic Synthetic Vision EFIS System Indicator.

G. TAWS INHIBIT ANNUNCIATOR SWITCH

The "TAWS INHIBIT" (Amber) annunciator switch when activated, illuminates and inhibits the visual and audible TAWS alerting functions. The "TAWS INHIBIT" annunciator switch is located near the EFIS II System Indicator.

H. AUDIO MUTE SWITCH

The Audio Mute Switch located on the Pilot's control wheel mutes Flight Logic Synthetic Vision EFIS System active voice alerts.

I. ENTER SWITCH

The Enter Switch is used when updating the Nav Aids Database or changing software. The Enter Switch is a momentary pushbutton switch located on the pilots instrument panels.

J. SAME SOURCE ANNUNCIATOR (Dual Sensor Installations Only)

The “SAME SOURCE” (Amber) annunciator is located on the center instrument panel.. The annunciator illuminates anytime both pilots select the same sensor (i.e. GPS, ADC, or AHRS).

K. SENSOR SELECT ANNUNCIATOR SWITCHES (Dual Sensor Installations Only)

A Sensor Select annunciator switch for each dual sensor installation is located near each pilot’s Flight Logic Synthetic Vision EFIS Indicators. When the ON SIDE sensor is selected, the top half of the annunciator will illuminate (Green). When the OFF SIDE sensor is selected, the bottom half of the annunciator will illuminate (Amber). The sensor name (i.e. GPS, ADC, AHRS) is printed on the face of each switch.

5.0 PERFORMANCE

No Change